

EXPERIMENTAL INVESTIGATIONS OF S01,11) ROD CATHODE OPERATION

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The service life of thermionic cathodes is important for a number of high current discharge devices, particularly several classes of electric thrusters such as electrothermal arcjets and magnetoplasmadynamic (MPD) engines. Low thrust levels dictate burn times of several thousand hours, and the cathodes of these devices are often the life-limiting component. Loss of cathode material in these devices is dependent primarily on the cathode operating temperature. Assurance of adequate service life therefore requires a quantitative understanding of cathode thermal behavior.

The thermal characteristics and mass loss rates of rod-shaped cathodes are being investigated in a dedicated cathode test facility. Cathode axial temperature distributions and erosion rates are being measured as a function of current level, ambient gas pressure and flow rate for a number of propellants including argon, helium, nitrogen and hydrogen. A camera-based imaging pyrometer system is being used to measure the temperature distributions and erosion rates are being determined by weight-loss measurements. In addition, near-cathode discharge properties such as pressure, electron density and temperature and potential distributions will be measured for certain operating conditions. The objective of these experiments is to provide a database of measurements for comparison with theoretical predictions (reported in another paper in this conference).

The paper will summarize the effect of operating conditions on temperature and mass loss rate and discuss transitions between tip attachment and diffuse modes of operation and transient thermal effects.